US008317371B1

(12) **United States Patent**
Khosrow et al.

(10) **Patent No.: US 8,317,371 B1**
(45) **Date of Patent: Nov. 27, 2012**

(54) **LED DOCK LIGHT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 435 days.

(21) Appl. No.: **12/650,139**

(22) Filed: **Dec. 30, 2009**

Related U.S. Application Data

(60) Provisional application No. 61/142,102, filed on Dec. 31, 2008.

(51) **Int. Cl.**
F21V 29/00 (2006.01)
F21L 4/04 (2006.01)

(52) **U.S. Cl.** **362/373**; 362/294; 362/184; 362/199

(58) **Field of Classification Search** 362/197–199, 362/202, 205, 184, 285, 287, 294, 240, 244, 362/245, 373, 249.02–249.05, 249.07–249.12
See application file for complete search history.

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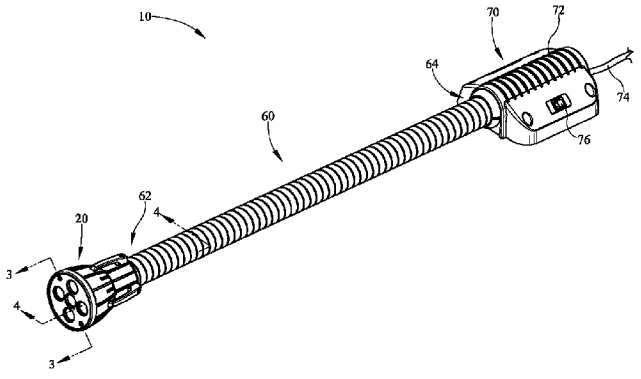
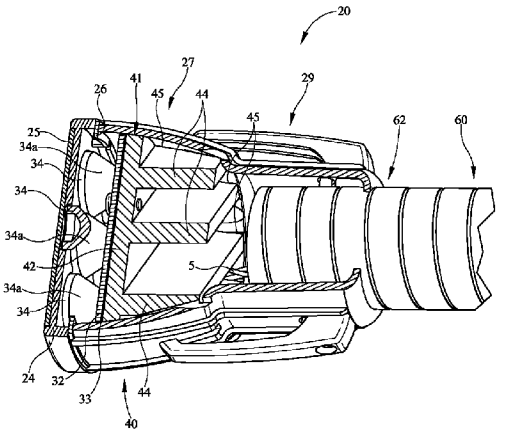
(57) **ABSTRACT**

A LED dock light has a support surface, a plurality of light emitting diodes, a heatsink, and a flexible neck member. The light emitting diodes are coupled to a first side of the support surface and the heatsink is coupled to a second side of the support surface. The heatsink has a plurality of heat fins.

14 Claims, 7 Drawing Sheets





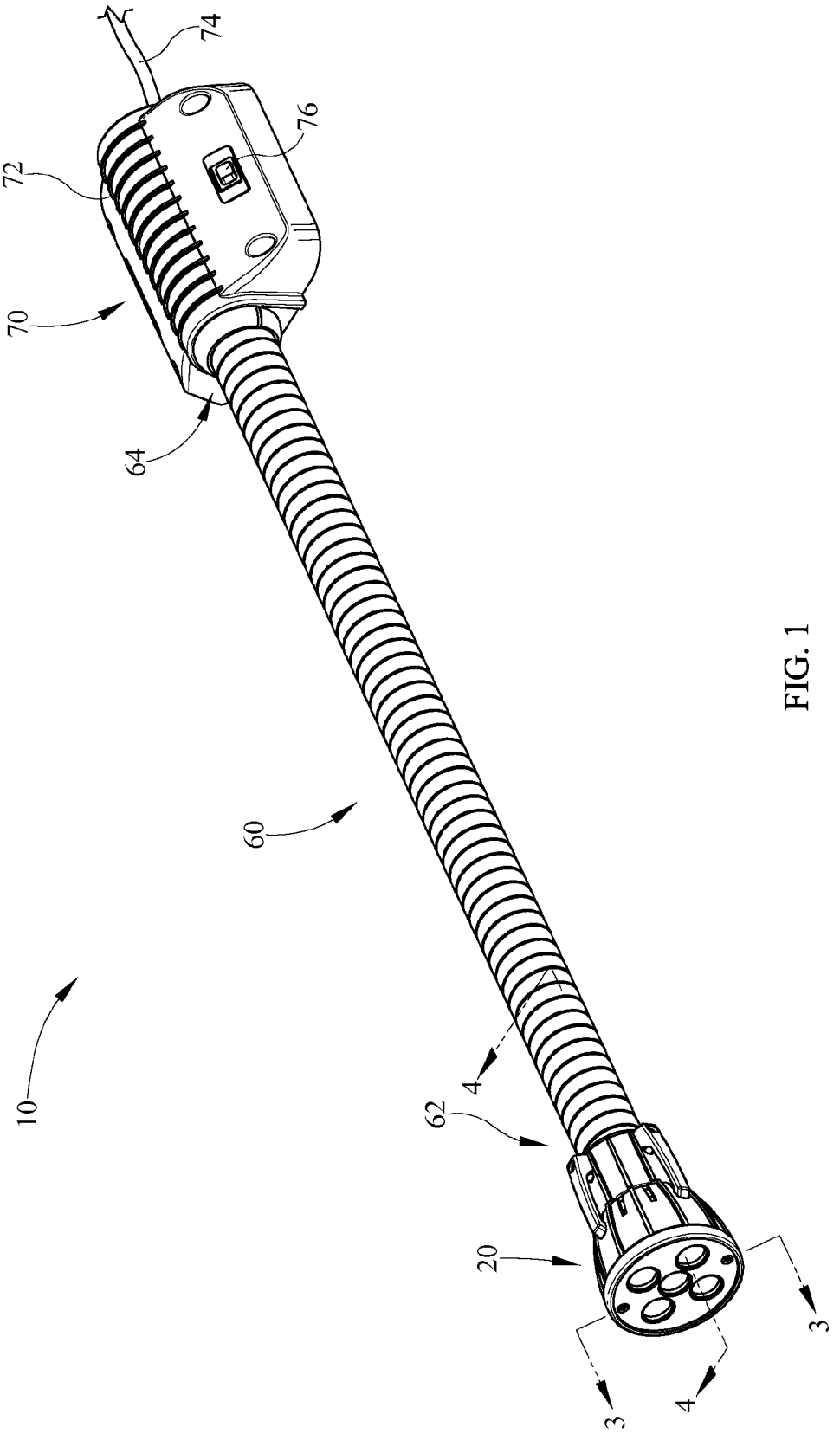


FIG. 1

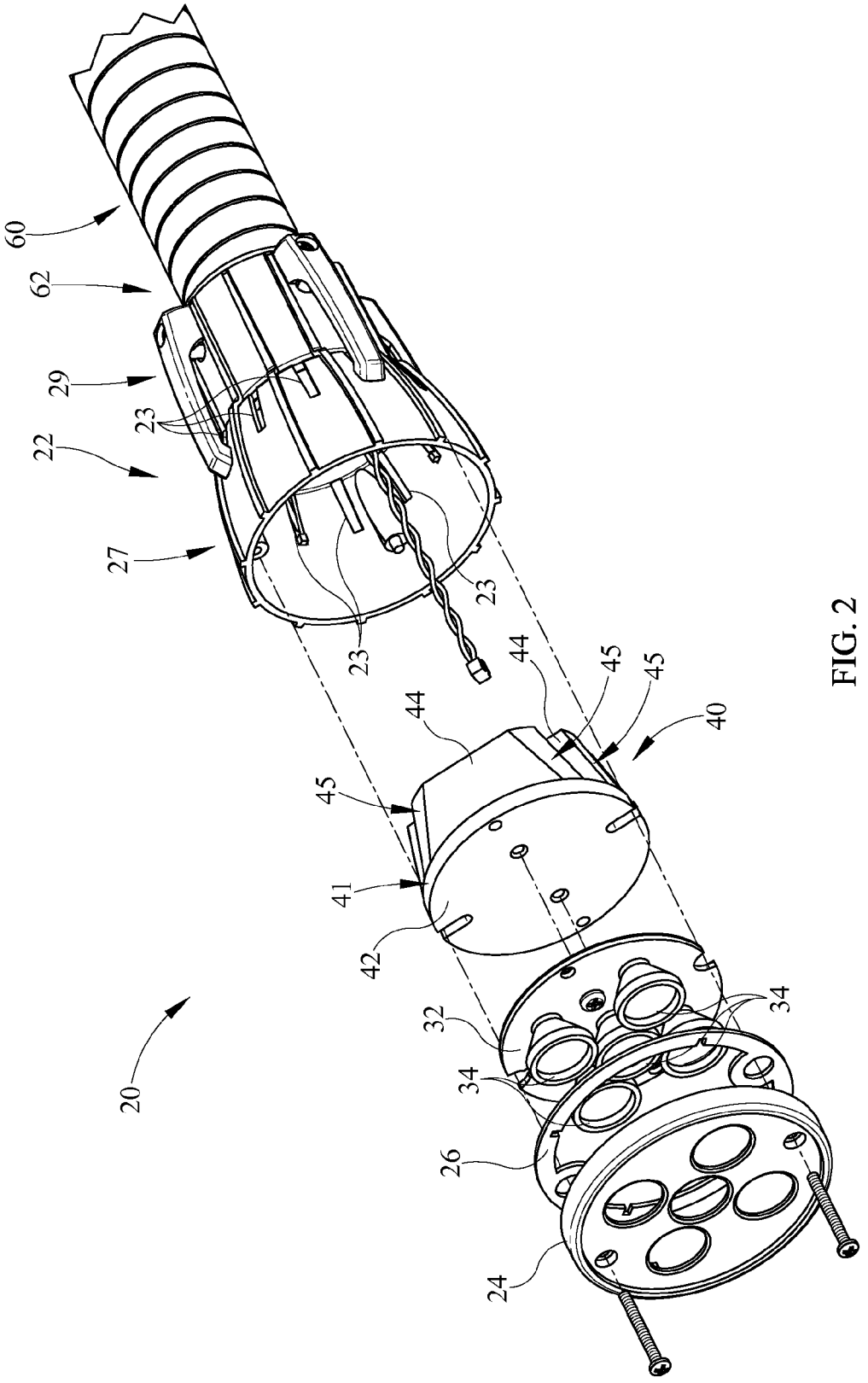


FIG. 2

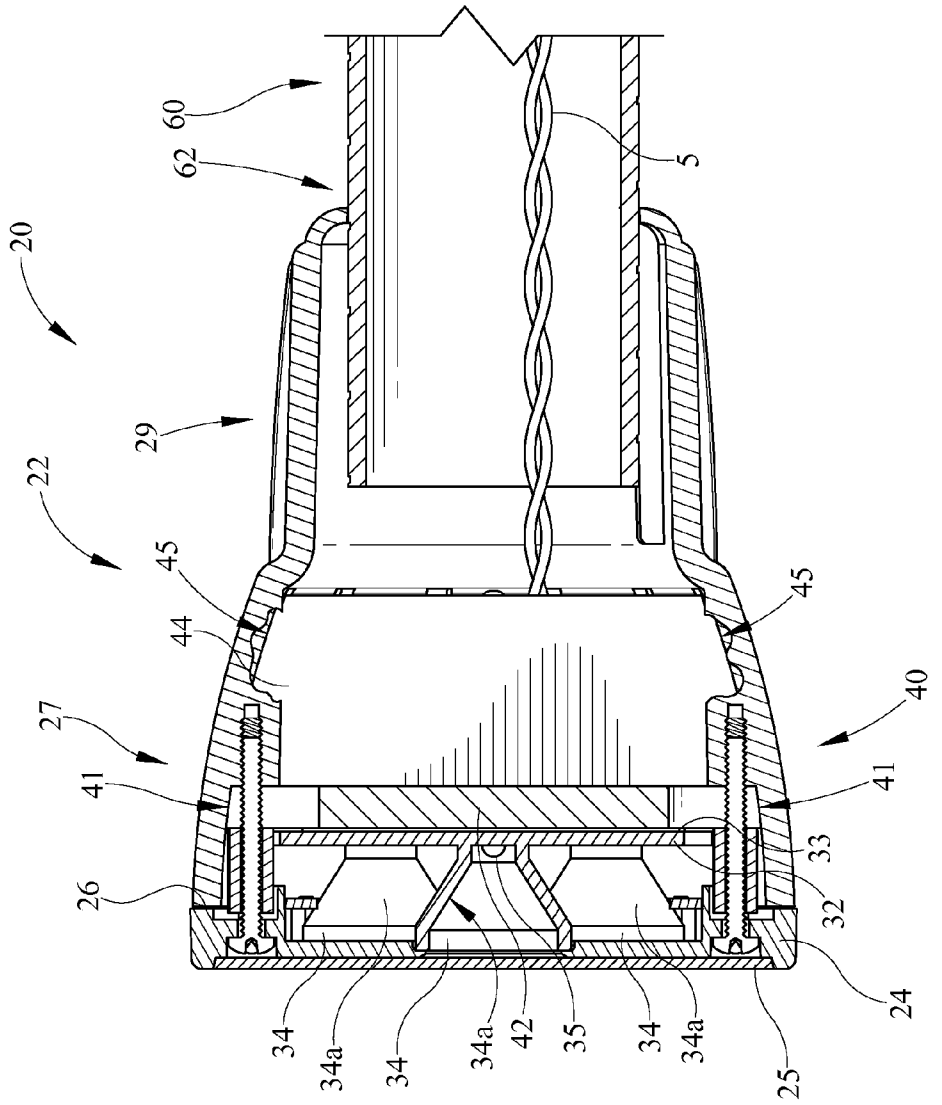

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FIG. 3

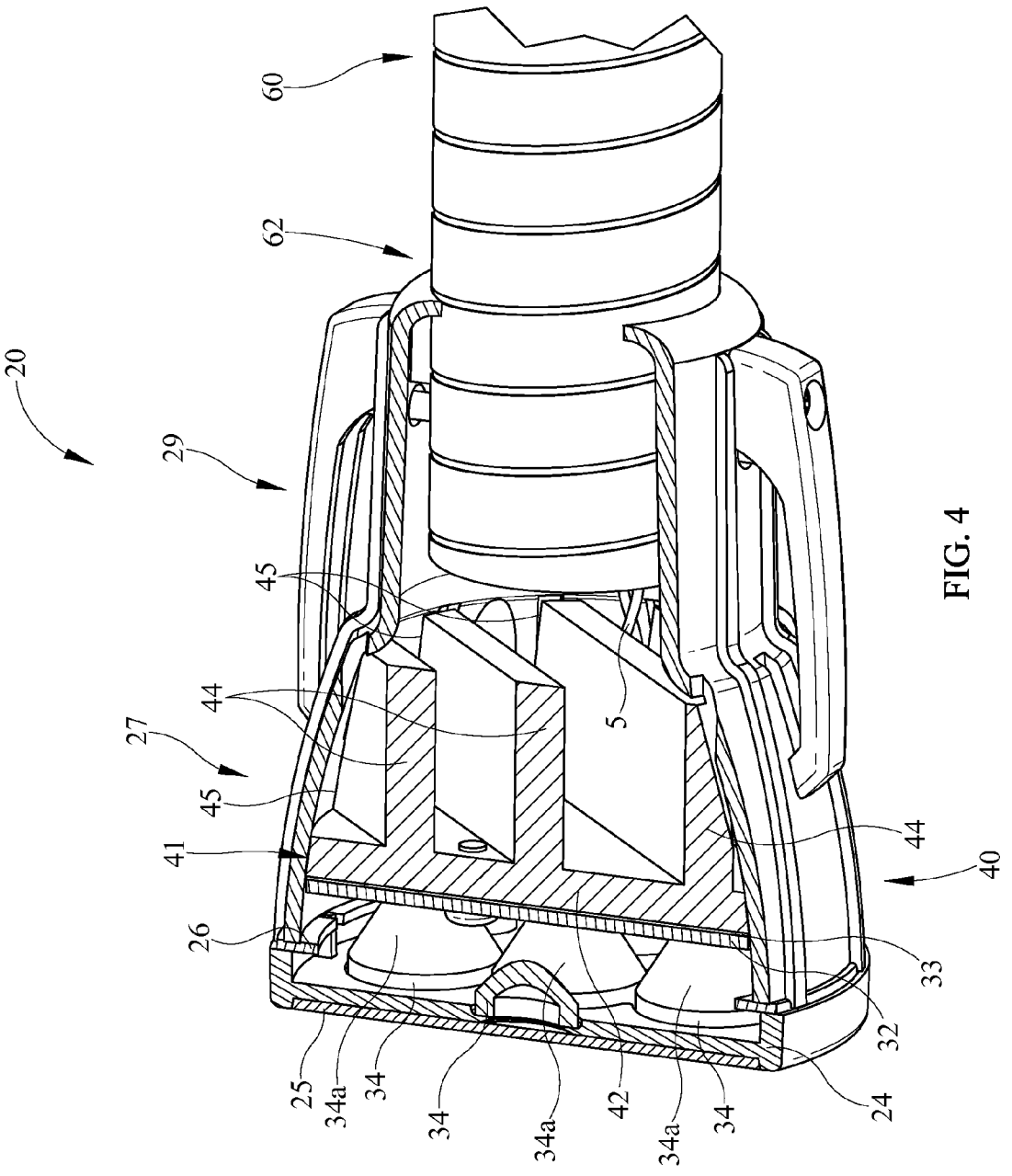
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FIG. 4

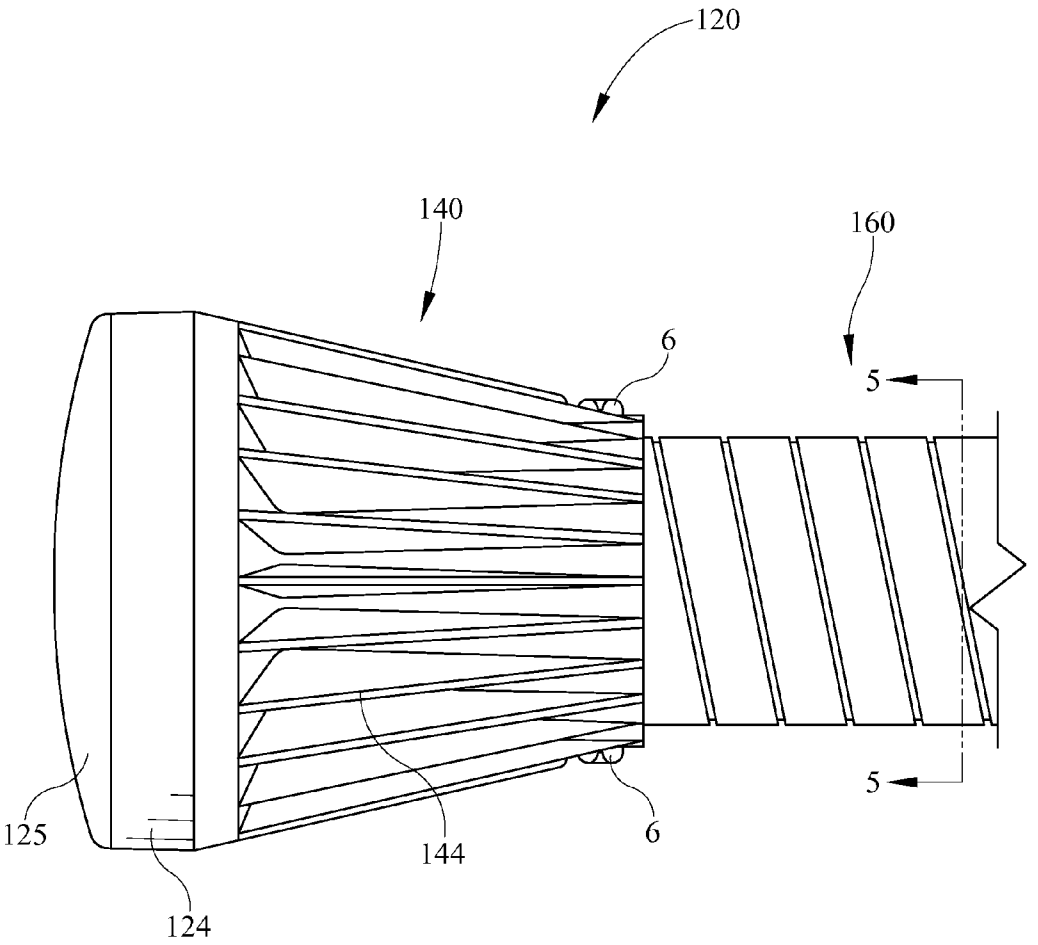

FIG. 5

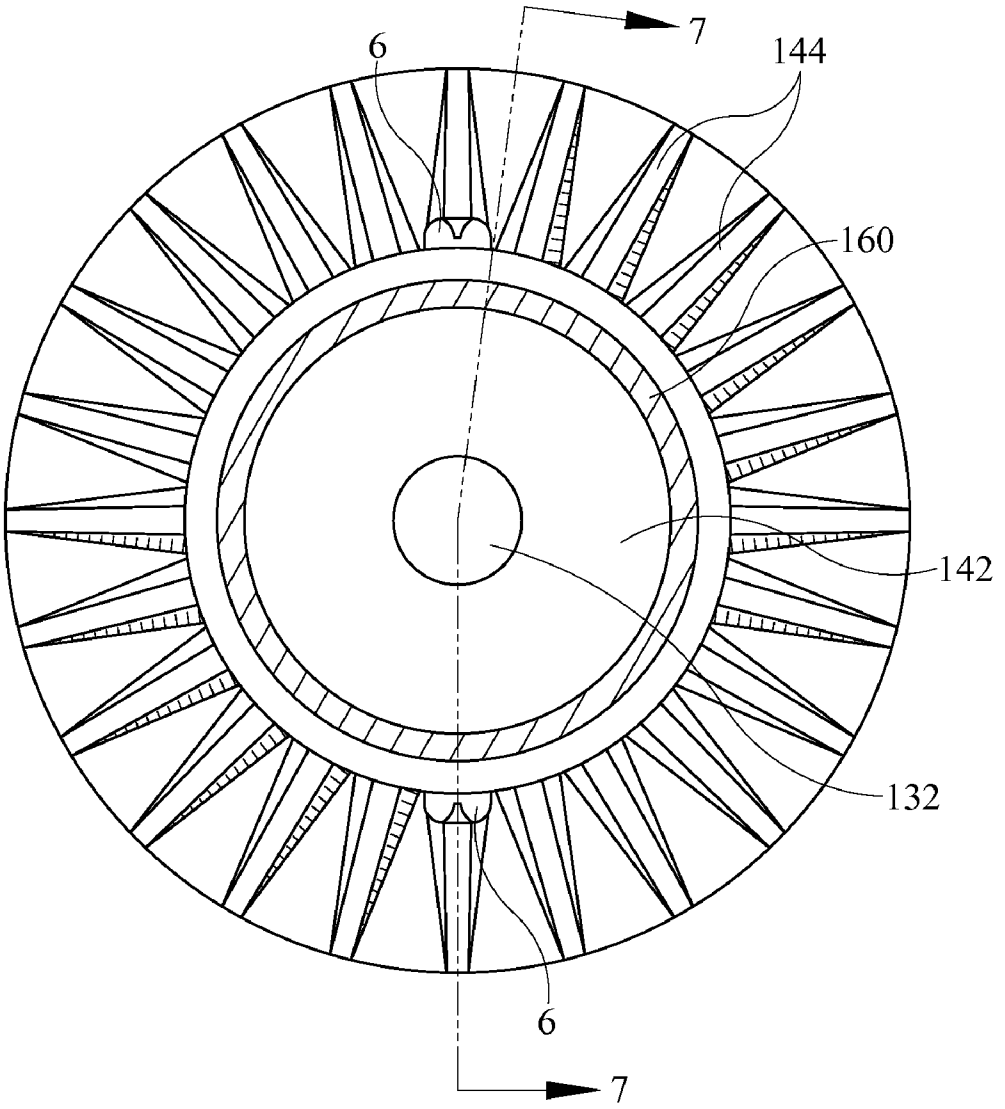

FIG. 6

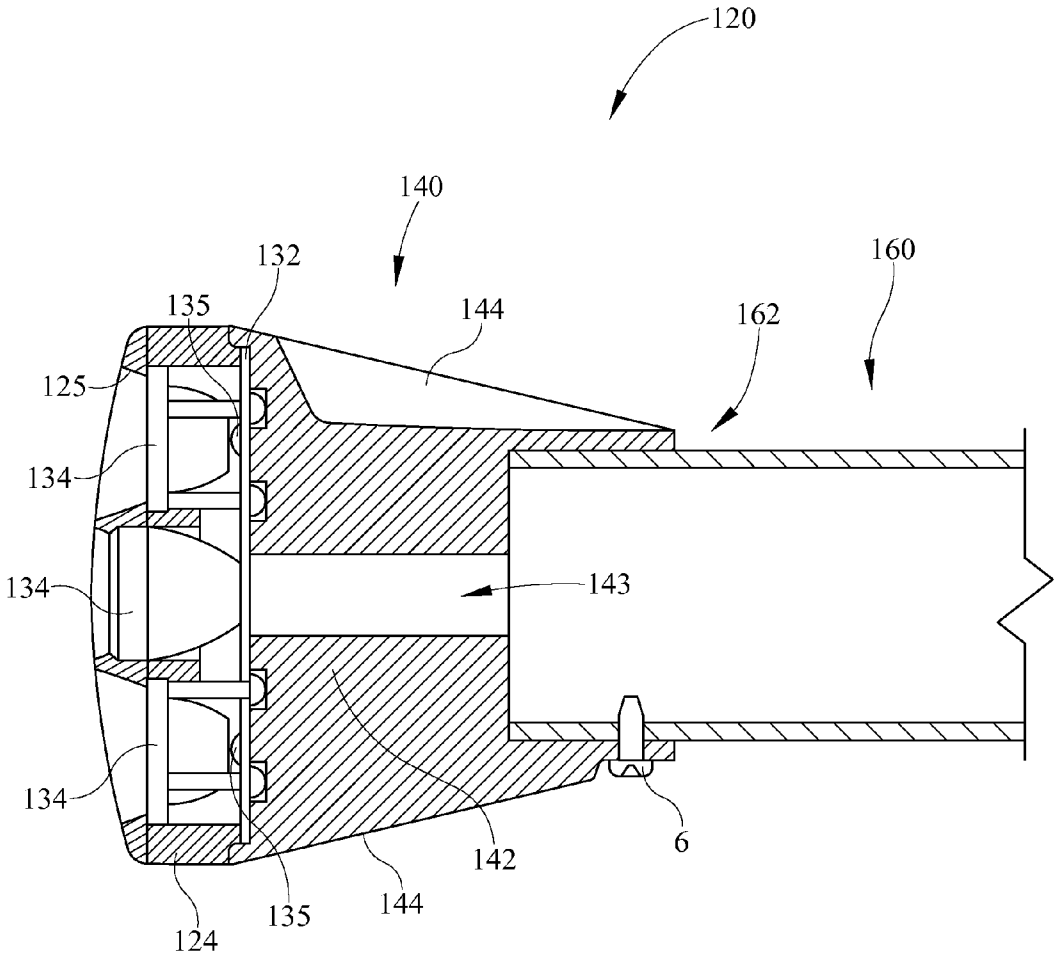

FIG. 7

LED DOCK LIGHT

CROSS-REFERENCE TO RELATED DOCUMENTS

This application claims priority to and benefit under 35 U.S.C. §119(e) to U.S. Provisional App. No. 61/142,102, filed on Dec. 31, 2008, entitled LED Docklight, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

This invention pertains generally to a dock light, and more particularly to a LED dock light.

BACKGROUND

Many prior art dock lights use incandescent lamps. However, incandescent lamps or bulbs are less efficient than light emitting diodes (LEDs). Typically, the efficiency is on the border of 50 or more lumens per watt. LEDs are more efficient than incandescent lights and have a longer life than incandescent lights. For example, LEDs may have a life of 50,000 hours before decreasing to 70% light output.

SUMMARY

Generally, in one aspect, an LED dock light includes a support surface having a first side and a second side. A plurality of light emitting diodes are coupled to the first side of the support surface and electrically connected to a power source. A plurality of optical pieces are each positioned over at least one of the light emitting diodes and have a reflector surrounding at least on of the light emitting diodes. The optical pieces are configured to direct light emitted by the light emitting diodes into a substantially narrow distribution pattern. The LED dock light also includes a heatsink coupled to the second side of the support surface and having a main body portion and a plurality of exposed heat fins extending radially about the main body portion. A flexible neck member has a first end coupled to the heatsink and surrounded by at least a portion of the heat fins of the heatsink and a second end that is coupled to a mounting base.

In some embodiments the support surface is a metal clad circuit board.

In some embodiments the heatsink has an interior void extending from the first end of the flexible neck member to the support surface.

In some embodiments a thermal layer is provided between the second side of the support surface and the heatsink.

Generally, in another aspect, an LED dock light includes a support surface having a first side and a second side. A plurality of light emitting diodes are coupled to the first side of the support surface and electrically connected to a power source. A plurality of optical pieces are each positioned over at least one of the light emitting diodes and are configured to direct light emitted by the light emitting diodes into a substantially narrow distribution pattern. The LED dock light also includes a heatsink coupled to the second side of the support surface and having a main body portion and a plurality of contoured heat fins extending from the main body portion. The LED dock light also includes a housing having a heatsink portion and an attachment portion. The heatsink portion substantially surrounds the heatsink and has an interior side in direct contact with the heat fins of the heatsink. A flexible neck member has a first end coupled to the attachment portion of the housing and a second end distal the first end. A mounting base is coupled to the flexible member proximal the second end.

In some embodiments the contoured heat fins of the heatsink mate with similarly contoured formations on the interior side of the heatsink portion of the housing to thereby allow transfer of heat from the support surface through the heat sink and to the housing.

In some embodiments the contoured heat fins extend perpendicularly from the main heatsink body.

In some embodiments the main body portion of the heatsink is in direct contact with a similarly contoured portion of the heatsink portion of the housing.

In some embodiments the attachment portion of the housing surrounds and is in direct contact with the first end of the flexible neck member. In some versions of those embodiments the main body portion of the heatsink is in direct contact with the heatsink portion of the housing.

In some embodiments the housing has a plurality of vents therethrough.

Generally, in another aspect, an LED dock light includes a support surface having a first side and a second side. A plurality of light emitting diodes are coupled to the first side of the support surface and electrically connected to a power source. A plurality of optical pieces are each positioned over at least one of the light emitting diodes and are configured to direct light emitted by the light emitting diodes into a substantially narrow distribution pattern. The LED dock light also includes a heatsink coupled to the second side of the support surface. The heatsink has a main body portion and a plurality of heat fins extending from the main body portion. Each of the heat fins have a first contoured surface on a first end and a second contoured surface on a second end distal the first end. The LED dock light also includes a housing having a heatsink portion and an attachment portion. The heatsink portion surrounds the heatsink and has an interior portion. The interior portion is in direct contact with each of the contoured surfaces of the heat fins of the heatsink to allow transfer of heat from the support surface through the heat sink and to the housing. A flexible neck member has a first end coupled to the attachment portion of the housing and a second end distal the first end. A mounting base is coupled to the flexible member proximal the second end.

In some embodiments the heat fins extend perpendicularly from the main body portion of the heatsink.

In some embodiments the main body portion of the heatsink is in direct contact with the heatsink portion of the housing.

In some embodiments the attachment portion of the housing surrounds and is in direct contact with the first end of the flexible neck member. In some embodiments the main body portion of the heatsink is in direct contact with the heatsink portion of the housing. In some versions of these embodiments the attachment portion of the housing surrounds and is in direct contact with the flexible neck member. In some versions of these embodiments the housing has a plurality of vents therethrough.

BRIEF DESCRIPTION OF THE ILLUSTRATIONS

FIG. **1** is a perspective view of a first embodiment of a dock light of the present invention.

FIG. **2** is an exploded perspective view of a light emitting diode head and a portion of a flexible neck of the first embodiment of the LED dock light of FIG. **1**.

FIG. **3** is a side view, in section, of the light emitting diode head and a portion of the flexible neck of the first embodiment of the LED dock light of FIG. **1** taken along the section line **3-3** of FIG. **1**.

FIG. **4** is a perspective view, in section, of the light emitting diode head and a portion of the flexible neck of the first embodiment of the LED dock light of FIG. **1** taken along the section line **4-4** of FIG. **1**, with a portion of a heatsink portion of a housing broken away.

FIG. **5** is a side view of a light emitting diode head and a portion of a flexible neck of a second embodiment of a flexible light emitting diode luminaire.

FIG. **6** is a rear view, in section, of the light emitting diode head and the portion of a flexible neck of the second embodiment of a flexible light emitting diode luminaire of FIG. **5** taken along the line **5-5** of FIG. **5**.

FIG. **7** is a side view, in section, of the light emitting diode head and a portion of the flexible neck of the second embodiment of the LED dock light of FIG. **5** taken along the line **7-7** of FIG. **6**.

DETAILED DESCRIPTION

It is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless limited otherwise, the terms "connected," "coupled," "in communication with" and "mounted," and variations thereof herein are used broadly and encompass direct and indirect connections, couplings, and mountings. In addition, the terms "connected" and "coupled" and variations thereof are not restricted to physical or mechanical connections or couplings. Furthermore, and as described in subsequent paragraphs, the specific mechanical configurations illustrated in the drawings are intended to exemplify embodiments of the invention and that other alternative mechanical configurations are possible.

With reference to FIG. **1** through FIG. **4**, a first embodiment of a flexible LED luminaire **10** is shown. The terms "LED" and "light emitting diode" as used herein are meant to be interpreted broadly and can include, but are not limited to, an LED of any luminosity and any light distribution pattern, and also includes, but is not limited to, an organic light emitting diode (OLED). With reference to FIG. **1**, flexible LED luminaire **10** has a head **20** and a mounting base **70** with a flexible neck **60** extending between head **20** and mounting base **70**. Mounting base **70** may be removably or fixedly coupled to a mounting surface such as, for example, a wall or an I-beam in a warehouse. In some embodiments a plurality of apertures may be provided in mounting base **70** for receiving mounting hardware such as a stud or a bolt. Mounting base **70** has a ballast housing **72** that encloses a light emitting diode power supply. In some embodiments the light emitting diode power supply is configured to receive a 120 Volt input and provide fifteen Watts of power to LEDs. In other embodiments of luminaire **10** light emitting diode power supplies may be located elsewhere on flexible LED luminaire **10**, located remotely from LED luminaire **10**, or omitted. An electrical cord **74** extends from mounting base **70** and may be coupled to an external power source to provide electrical power to the light emitting diode power supply enclosed within housing **72**. In other embodiments of luminaire **10** electrical cord **74** may be omitted and a power source internal to flexible LED luminaire **10** may be used. A switch **76** is located on ballast housing **72** and may be actuated to selectively power flexible LED luminaire **10**. In other embodiments of luminaire **10** switch **76** may be located on head **20**, flexible neck **60**, located remotely from flexible LED luminaire **10**, or omitted. In some embodiments an electrical receptacle that is in electrical connectivity with electrical cord **74** may be added to ballast housing **72** for convenience.

Flexible neck **60** has a first end **62** coupled to head **20** and a second end **64** coupled to ballast housing **72**. Flexible neck **60** may be adjusted to and temporarily fixed at a plurality of orientations to enable head **20** to be directed toward a desired illumination area. Flexible neck **60** may be readjusted to and temporarily fixed to another orientation as desired. In some embodiments of luminaire **10** flexible neck **60** may house electrical wiring that extends from mounting base **70** to head **20**. In some embodiments of luminaire **10** flexible neck **60** may be constructed from a metal having desirous heat distribution properties such as, but not limited to, stainless steel or aluminum.

With continuing reference to FIGS. **1-4**, a housing **22**, a bezel **24**, and a gasket **26** enclose a support surface **32** having five LED optical pieces **34** placed over five corresponding LEDs **35** that are coupled to support surface **32**. Optical pieces **34** include a reflector **34***a* substantially surrounding each LED **35** and having a lens on an opposite end of the reflector **34***a*. A lens, **25**, shown in FIG. **3** and FIG. **4**, may be placed over bezel **24** if desired to, for example, seal housing **22**, prevent contact with optical pieces **34**, or to alter optical characteristics of light exiting through lens **25**. Housing **22** may be provided with one or more vents **23** therethrough to allow for better airflow and heat dissipation. In some embodiments of LED dock light **10** support surface **32** may be a flame retardant four (FR-4) or other common printed circuit board. In other embodiments support surface **32** is a metallic board with advantageous heat distribution properties such as, but not limited to, aluminum. In some embodiments support surface **32** is a metal clad circuit board with an aluminum core. In other embodiments support surface **32** is a shape other than circular, such as, but not limited to square or rectangular. In some embodiments optical pieces **34** and their corresponding LEDs are configured to produce a narrow beam distribution so that far away areas may be appropriately illuminated. In some embodiments reflectors **34***a* are configured to direct light emitted by LEDs **35** into narrow beams that will sufficiently illuminate a far end of a common semi trailer when the luminaire **10** is located at a near end of the semi trailer that is distal the far end. In some embodiments each LED consumes approximately three watts of power and outputs approximately 180 lumens.

Housing **22** has a heatsink portion **27** that surrounds and is in contact with a heatsink **40**. Housing **22** also has an attachment portion **29** that is coupled to and surrounds first end **62** of flexible neck **60**. Housing **22** is constructed from a metal having desirable heat distribution properties, such as, but not limited to, aluminum or stainless steel. Heatsink **40** is coupled to and in thermal connectivity with support surface **32**. Heatsink **40** is constructed from a metal having desirable heat distribution properties, such as, but not limited to, aluminum. Heatsink **40** has a main body portion **42** and a plurality of heat fins **44** extending away from main body portion **42**. Contoured portions **45** are provided on distal ends of each heat fin **44**. Contoured portions **45** correspond to the contour of heatsink portion **27** of housing **22**. When LED dock light **10** is

assembled, contoured portions **45** of heat fins **44** contact heatsink portion **27** of housing **22**. In the embodiment of FIGS. **1-4** an outer periphery **41** of main body portion **42** is also contoured to correspond to the contour of heatsink portion **27** and contacts heatsink portion **27** of housing **22** when dock light **10** is assembled.

Heatsink **40** dissipates heat generated by the LEDs provided on support surface **32**. Some of the heat is dissipated by main body **42** and some is transferred from main body **42** to heat fins **44** and dissipated by heat fins **44**. Some of the heat is transferred from heatsink **40** to housing **22** through direct contact between contoured portions **45** and heatsink portion **27** of housing **22** and some of the heat is transferred from heatsink **40** to housing **22** through direct contact between outer periphery **41** of main body portion **42** and heatsink portion **27** of housing **22**. Some heat is also transferred from heatsink **40** to housing **22** through indirect thermal transfer.

With particular reference to FIG. **3** and FIG. **4**, first end **62** of flexible neck **60** is coupled to and surrounded by attachment portion **29** of housing **22**. Attachment portion **29** of housing **22** may contact or be sufficiently close to second end **62** of flexible neck **60** so as to allow heat to be transferred from housing **22** to flexible neck **60** to aid in dissipation of heat. Heatsink **40**, housing **22**, and flexible neck **60** provide heat dissipation for LEDs mounted on support surface **32**. A thermal layer **33** may be provided between support surface **32** and heatsink **40** to aid in heat dissipation. In some embodiments thermal layer **33** may be a thermal pad and in other embodiments thermal layer **33** may be a thermal compound, such as, but not limited to a thermal silicon paste. Thermal layer **33** may be omitted in other embodiments if not desired for heat dissipation.

With reference to FIG. **5** through FIG. **7**, a second embodiment of a head **120** is shown. Head **120** has a heatsink **140** coupled to and in thermal connectivity with a support surface **132** having a plurality of LEDs **135**. Optical pieces **134** are provided over corresponding LEDs **135**. Heatsink **140** has an interior void **143** and a main body portion **142** and a plurality of heat fins **144** extending radially about interior void **143** and main body portion **142**. In some embodiments heatsink **140** is constructed from a metal having advantageous heat distribution properties, such as, but not limited to, aluminum. In some embodiments electrical wiring may extend through interior void **143** to provide power to LEDs **135**. Heat fins **144** are exposed and form part of the housing for head **120**. Heat sink **140** surrounds a portion of first end **162** of flexible neck **160** and is coupled to first end **162** of flexible neck **160** by screws **6**. In the embodiment of FIGS. **5-7** first end **162** contacts heatsink **140** allowing heat to be better transferred from second heatsink **140** to flexible neck **160** to aid in dissipation of heat. Flexible neck **160** may be constructed from a metal having desirable heat distribution properties, such as, but not limited to, aluminum or stainless steel.

A cover **124** and a lens **125** couple to heatsink **140** to enclose support surface **132** and corresponding LEDs **135** that are coupled to support surface **132**. Lens **125** may be placed over cover **124** if desired for sealing support surface **132**, optical pieces **134**, and/or LEDs **135** or to alter optical characteristics of light exiting through lens **124**. Heatsink **140** dissipates heat generated by the LEDs provided on support surface **132**. Some of the heat is dissipated by main body **142** and some is dissipated by heat fins **144**. Some of the heat is transferred from heatsink **140** to flexible neck **160** through direct contact between heatsink **140** and first end **162** of flexible neck **160**. Some of the heat is transferred from heatsink main body portion **142** and fins **144** of heatsink **140** to the external environment.

The foregoing description has been presented for purposes of illustration. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. It is understood that while certain forms of the LED dock light have been illustrated and described, it is not limited thereto except insofar as such limitations are included in the following claims and allowable functional equivalents thereof.

We claim:

1. A LED dock light comprising:

a support surface having a first side and a second side;

a plurality of light emitting diodes coupled to said first side of said support surface and electrically connected to a power source;

a plurality of optical pieces, each said optical piece positioned over a light emitting diode, wherein said optical pieces are configured to direct light emitted by said light emitting diodes into a substantially narrow distribution pattern;

a heatsink coupled to said second side of said support surface, said heatsink having a main body portion and a plurality of contoured heat fins extending from said main body portion;

a housing having a heatsink portion and an attachment portion, said heatsink portion substantially surrounding said heatsink and having an interior side in direct contact with said heat fins of said heatsink;

a flexible neck member having a first end and a second end, said first end coupled to said attachment portion of said housing; and

a mounting base coupled to said flexible neck member proximal said second end;

wherein said contoured heat fins of said heatsink mate with similarly contoured formations on said interior side of said heatsink portion of said housing to allow transfer of heat from said support surface through said heat sink and to said housing.

2. The LED dock light of claim **1**, wherein said contoured heat fins extend perpendicularly from said main heatsink body.

3. The LED dock light of claim **2**, wherein said main body portion of said heatsink is in direct contact with said heatsink portion of said housing.

4. The LED dock light of claim **3**, wherein said contoured heat fins extend perpendicularly from said main heatsink body.

5. The LED dock light of claim **2**, wherein said housing has a plurality of vents therethrough.

6. The LED dock light of claim **1**, wherein said main body portion of said heatsink is in direct contact with a similarly contoured portion of said heatsink portion of said housing.

7. The LED dock light of claim **1**, wherein said attachment portion of said housing surrounds and is in direct contact with said first end of said flexible neck member.

8. A LED dock light comprising:

a support surface having a first side and a second side;

a plurality of light emitting diodes coupled to said first side of said support surface and electrically connected to a power source;

a plurality of optical pieces, each said optical piece positioned over a light emitting diode, wherein said optical pieces are configured to direct light emitted by said light emitting diode into a substantially narrow distribution pattern;

a heatsink coupled to said second side of said support surface, said heatsink having a main body portion and a

plurality of heat fins extending from said main body portion, each of said heat fins having a first contoured surface on a first end thereof and a second contoured surface on a second end thereof distal said first end;

a housing having a heatsink portion and an attachment portion, said heatsink portion surrounding said heatsink and having an interior portion, said interior portion in direct contact with each said contoured surface of said heat fins of said heatsink to allow transfer of heat from said support surface through said heat sink and to said housing;

a flexible neck member having a first end and a second end, said first end coupled to said attachment portion of said housing; and

a mounting base coupled to said flexible neck member proximal said second end.

9. The LED dock light of claim **8**, wherein said heat fins extend perpendicularly from said main body portion of said heatsink.

10. The LED dock light of claim **8**, wherein said main body portion of said heatsink is in direct contact with said heatsink portion of said housing.

11. The LED dock light of claim **8**, wherein said attachment portion of said housing surrounds and is in direct contact with said first end of said flexible neck member.

12. The LED dock light of claim **8**, wherein said main body portion of said heatsink is in direct contact with said heatsink portion of said housing.

13. The LED dock light of claim **12**, wherein said attachment portion of said housing surrounds and is in direct contact with said flexible neck member.

14. The LED dock light of claim **13**, wherein said housing has a plurality of vents therethrough.

* * * * *